Risk Assessment Vs Exposure Assessment - the Future ?

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Major Information Sources

- ***Risk Assessment Principles For the Industrial Hygienist*** - Jayjock, Lynch and Nelson, AIHA Press
- ***A Strategy For Assessing And Managing Occupational Exposures*** - Mulhausen and Damiano, AIHA Press
- **Symposium on Risk Assessment** - AIHA, New Orleans, 1999

The Practice Of Industrial Hygiene

- Classical
- OSHA Driven
- Downsized
- Deregulated

?

- Avoid Worker's Comp

  Do The Right Thing
- Avoidance Of Penalties
- Expanded To Environmental
- Profitability, Enhance Performance, "Bottom Line"

?

RISK ASSESSMENT

A logical, objective and quantitative approach to analyzing and interpreting data with the purpose of PREDICTING potential adverse effects.

RISK ASSESSMENT

A formal way to CALCULATE risk so that informed decisions can be made.

Jayjock, et al

Risk Assessment

$$\text{Risk} = \frac{\text{Probability of Health Effect}}{\text{Unit Exposure}} \bullet \text{Level Of Exposure}$$

$$\text{Risk} = \frac{\text{Probability of Health Effect}}{\text{Absorbed Dose}} \bullet \frac{\text{Absorbed Dose}}{\text{Exposure Limit}}$$

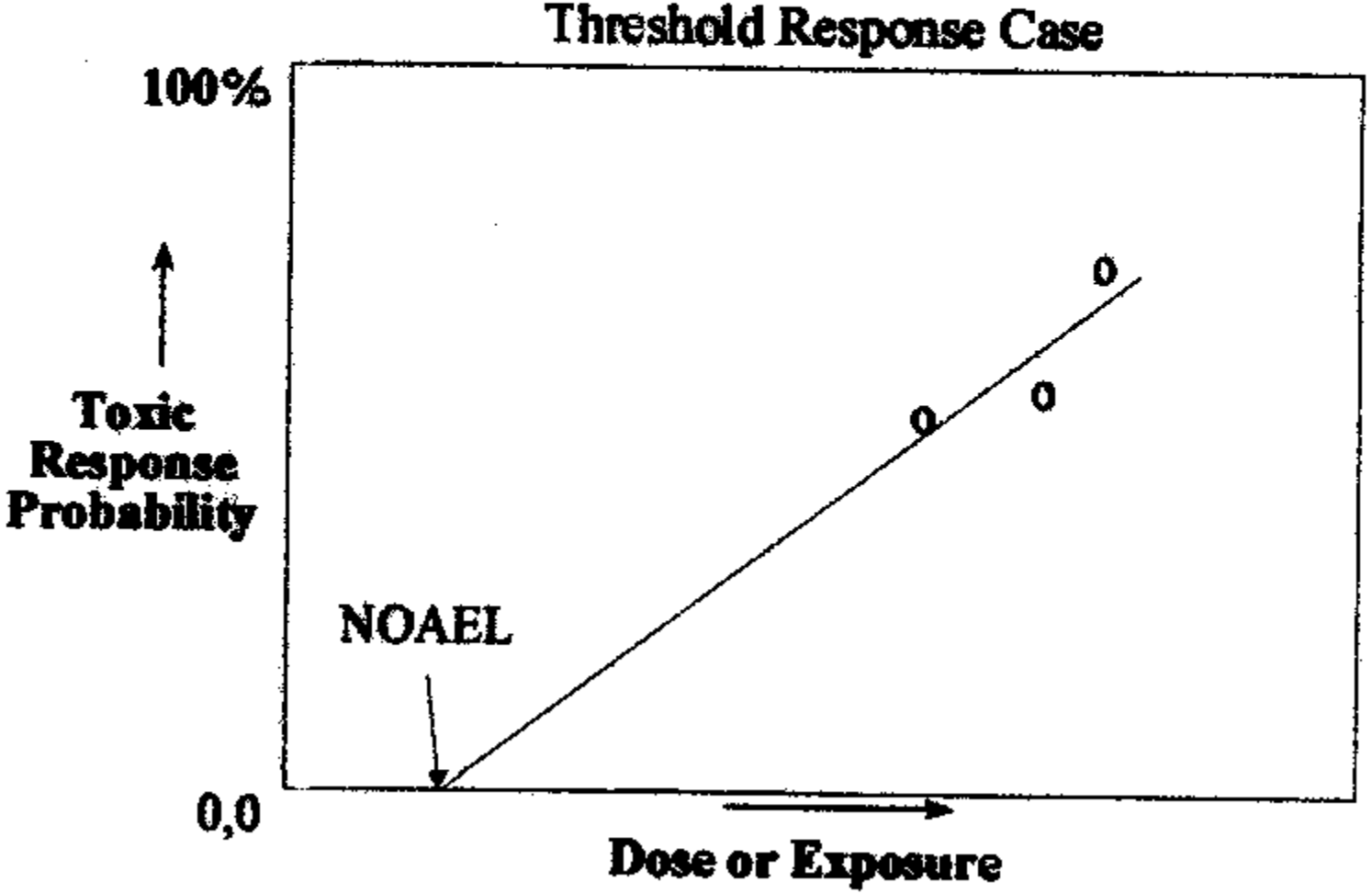
$$\text{Risk} = \frac{\text{Exposure}}{\text{Exposure Limit}}$$

Jayjock, et al

Dose-Response Models

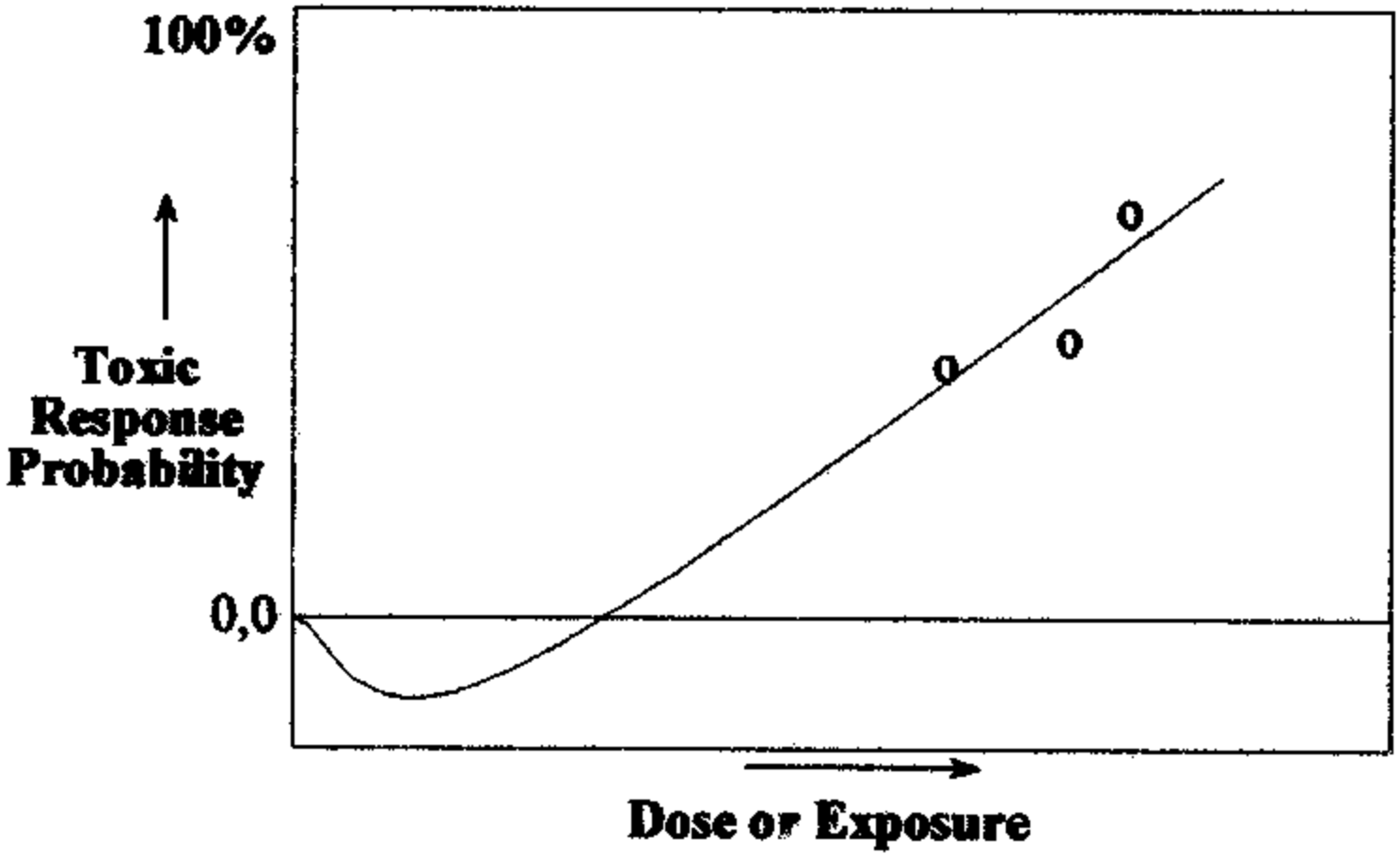
- Threshold Assumed
- No Threshold Assumed

Dose-Response Curve



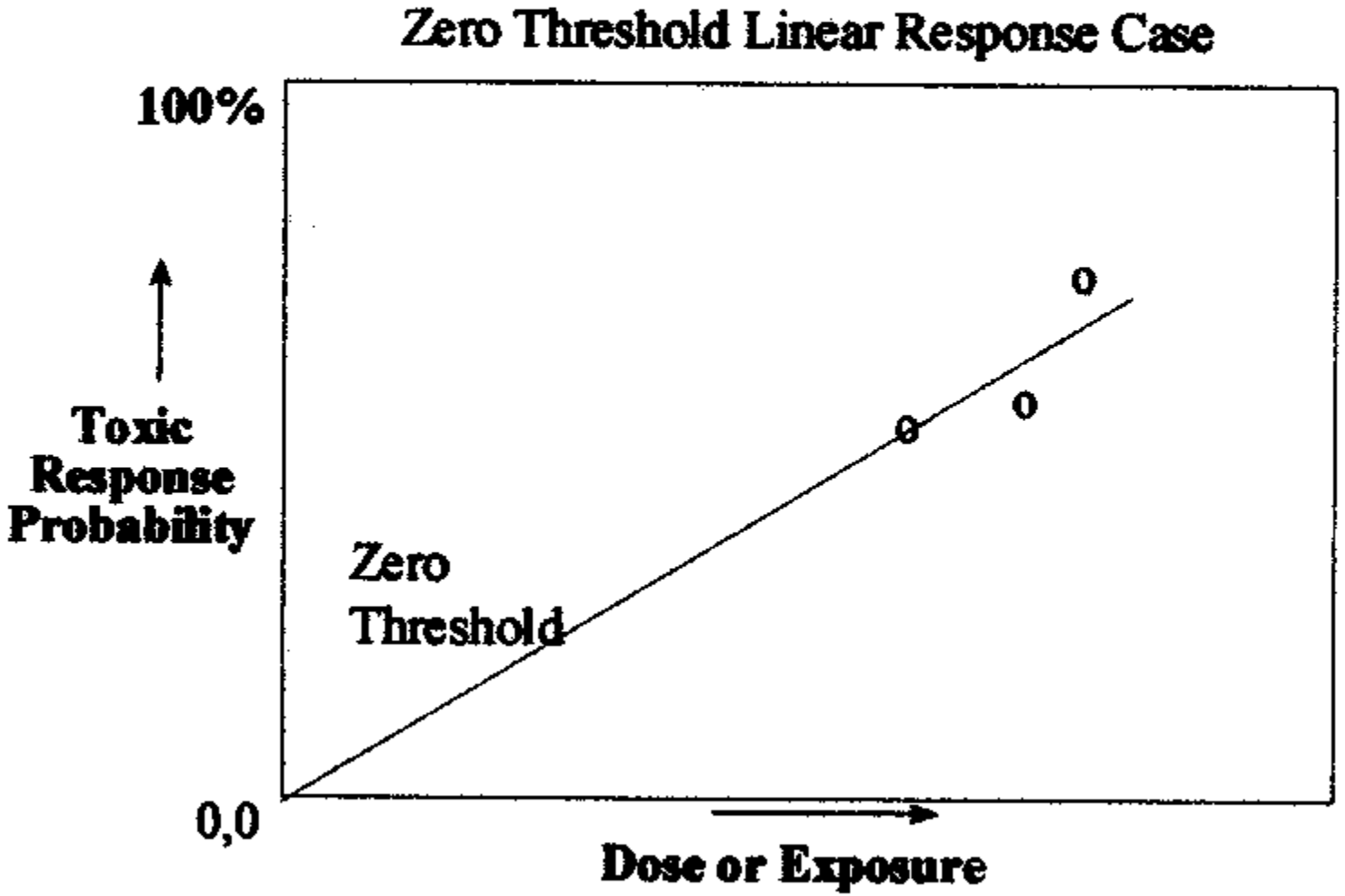
Dose-Response Curve

Non-Linear Response Case - Hormesis



Monty Herr

Dose-Response Curve



Monty Herr

OCCUPATIONAL INDUSTRIAL HYGIENE	ENVIRONMENTAL RISK ASSESSMENT
Recognition	Hazard Identification
Evaluation	Exposure Assessment Toxicity Assessment Risk Characterization
Control	Risk Management
Hazard Communication	Risk Communication

OCCUPATIONAL INDUSTRIAL HYGIENE

OELs

- PEL
- TLV
- STEL
- Ceiling Limit
- WEEL

Exposure Profile

Acceptable Risk = 10^{-3}

ENVIRONMENTAL RISK ASSESSMENT

RfD

Chronic/Subchronic
Oral/Inhalation/Dermal

SLOPE

CDI - LCR/NHQ

Lifetime Cancer Risk/Noncancer Hazard Quotient

Acceptable Risk = 10^{-6}

OCCUPATIONAL INDUSTRIAL HYGIENE	ENVIRONMENTAL RISK ASSESSMENT
Adult, healthy	Young, Old, Infirmed
30 years	Lifetime
Trained	Unaware/Uneducated
8 hrs/day	24 hrs/day
5 days/wk	7 days/wk
Inhalation, Skin, Ingest	Pathways - water, soil, air
Physical Agents	Chronic
Averaging Times	

RISK ASSESSMENT

Measuring risk is scientific. Judging the acceptability of risk is a value judgement.

Jayjock, et al

PUTATIVE RISK

ACCEPTABLE RISK

RISK ASSESSMENT

Risk assessment is not an objective scientific process; facts and values frequently merge when we deal with issues of high uncertainty; cultural factors affect the way people assess risk.

Sheila Jasanoff

RISK ASSESSMENT

Risk assessment is always clouded in uncertainty.

Jayjock, et al

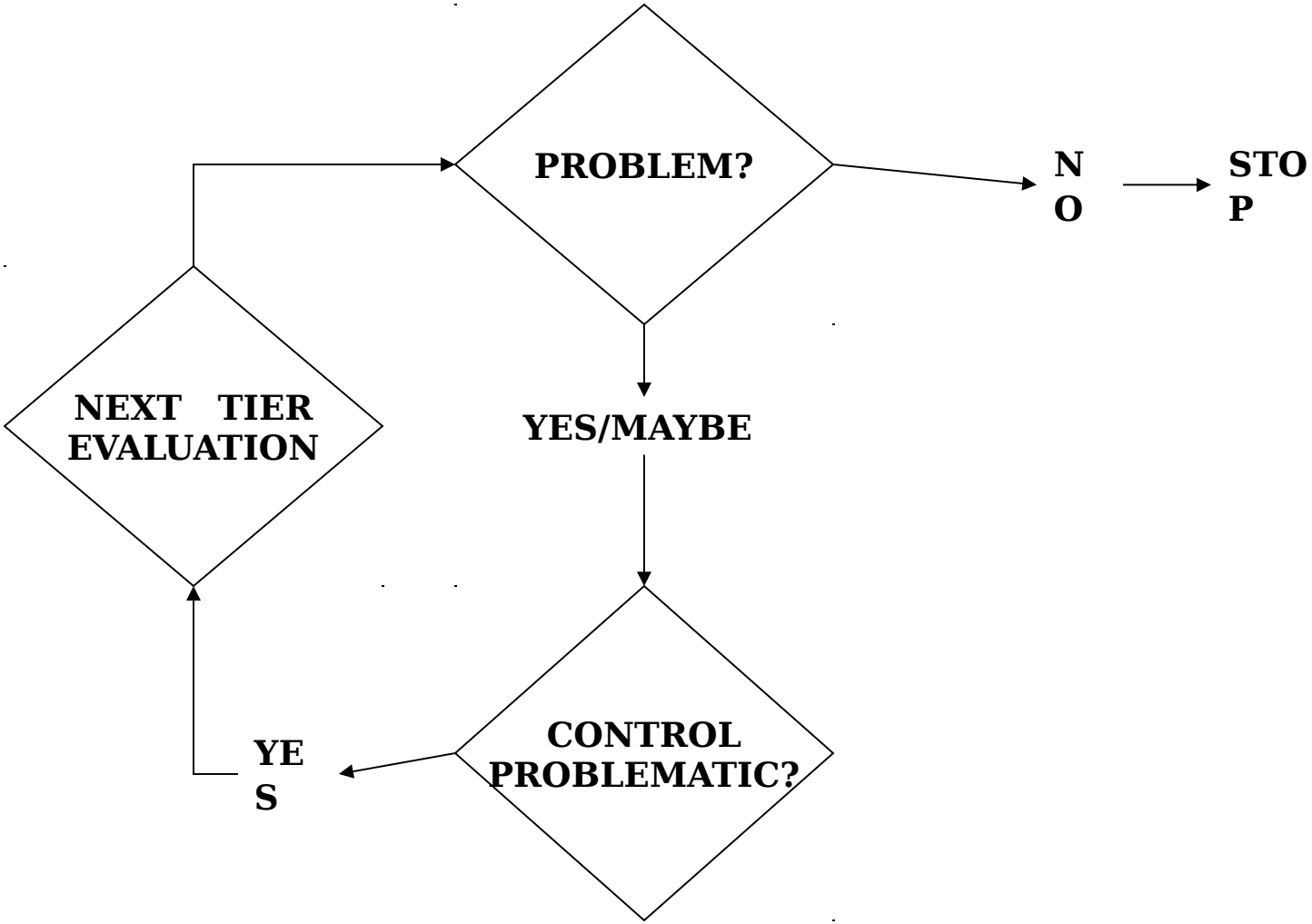
ASTM - RBCA Tiered Approach To Risk Assessment

- Tier 0 - Expert Judgement
- Tier 1 - Look-up Table
- Tier 2 - Screening Level Models and

  More Data

- Tier 3 - Complex Survey

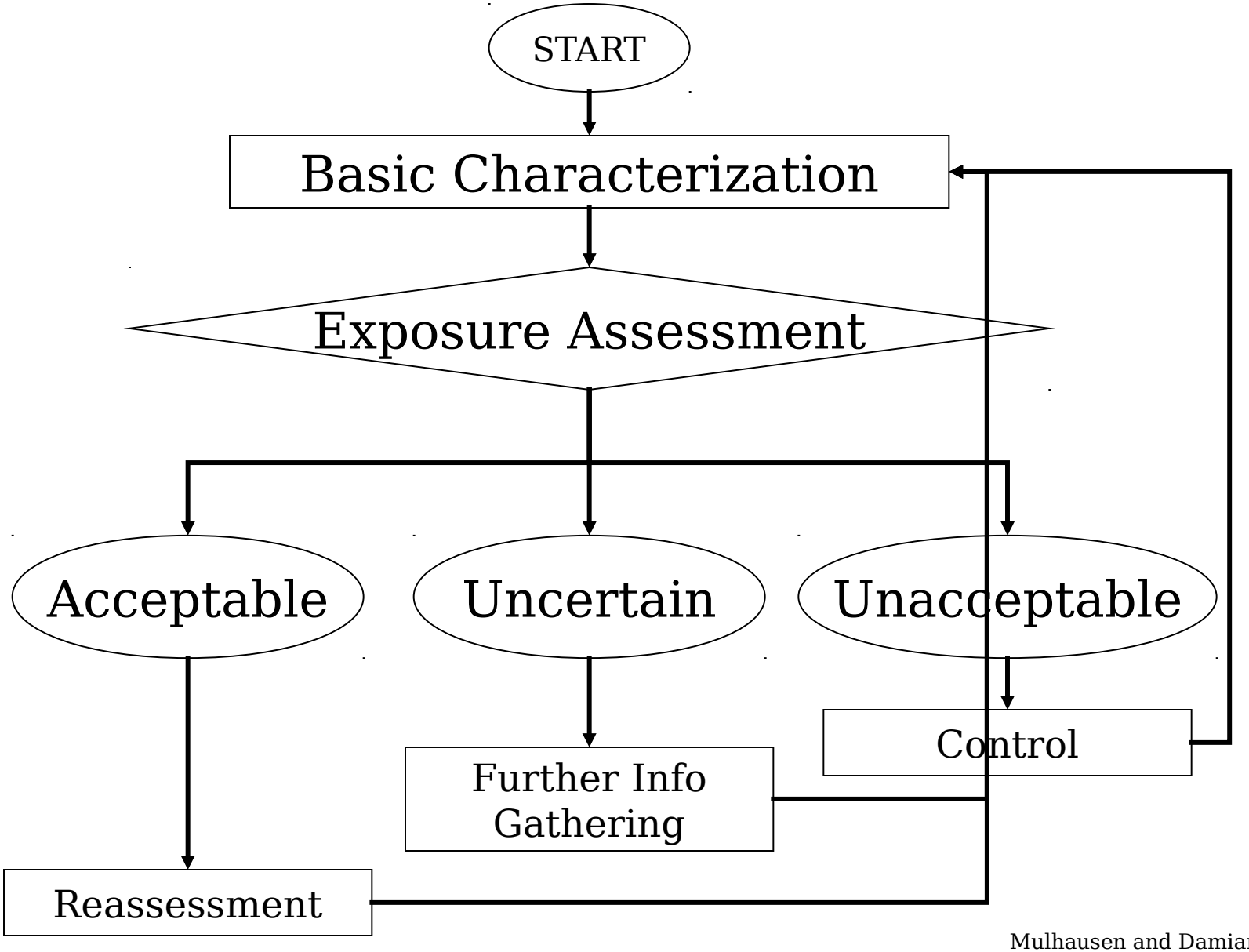
Iterative (Tiered) Approach To Risk Assessment



AIHA Exposure Assessment Strategy

1. Start - Establish strategy
2. Basic Characterization
3. Exposure Assessment
4. Further Information Gathering
5. Health Hazard Control
6. Reassessment
7. Communication/Documentation

EXPOSURE ASSESSMENT STRATEGY



Mulhausen and Damiano

AIHA Exposure Assessment Strategy

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3. **Exposure Assessment**
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AIHA Exposure Assessment Strategy

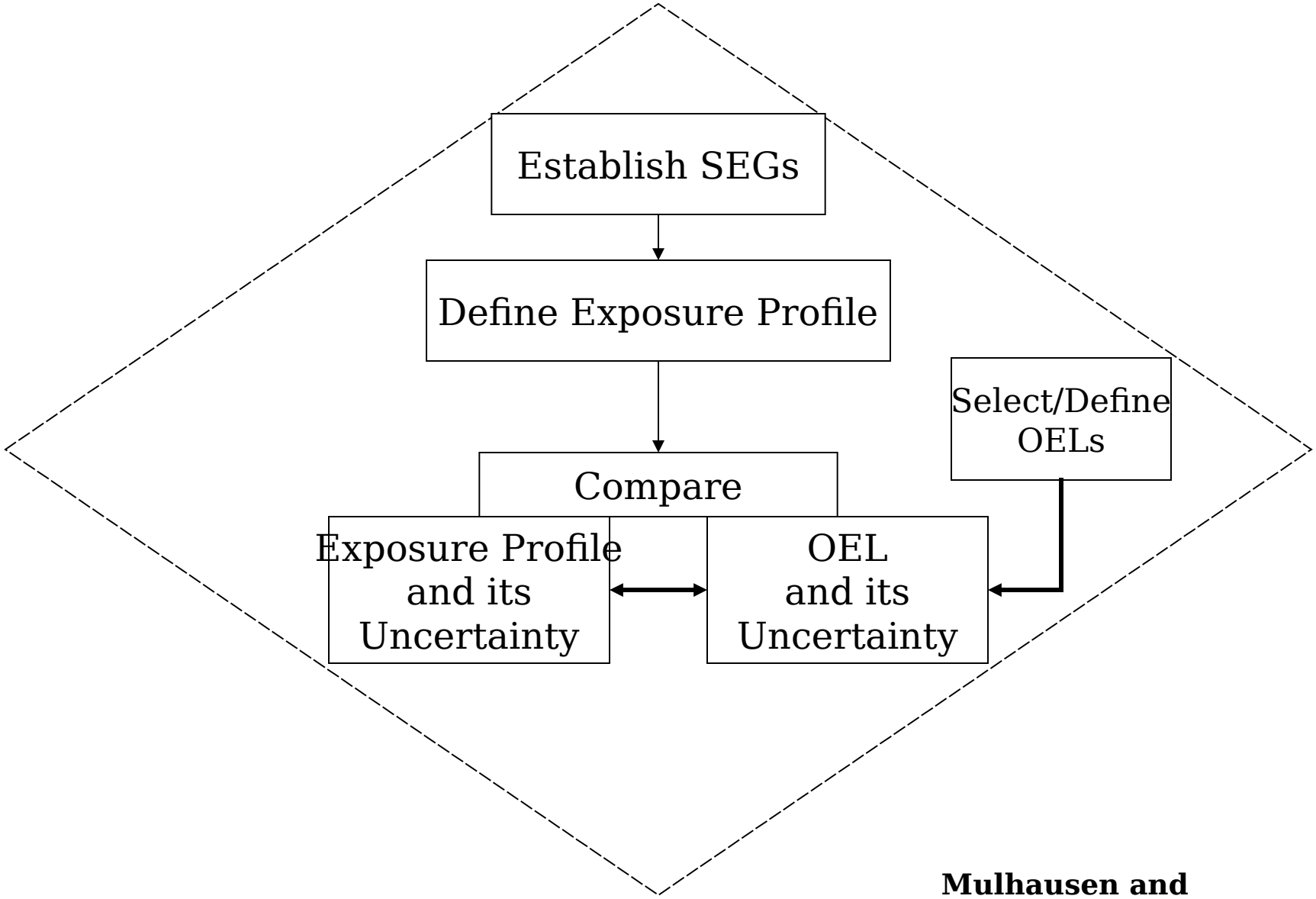
3. Exposure Assessment

   – Define Similar Exposure Groups (SEGs)

   – Define Exposure Profiles

   – Make Judgements on Acceptability of the Exposure Profile For Each SEG

EXPOSURE ASSESSMENT



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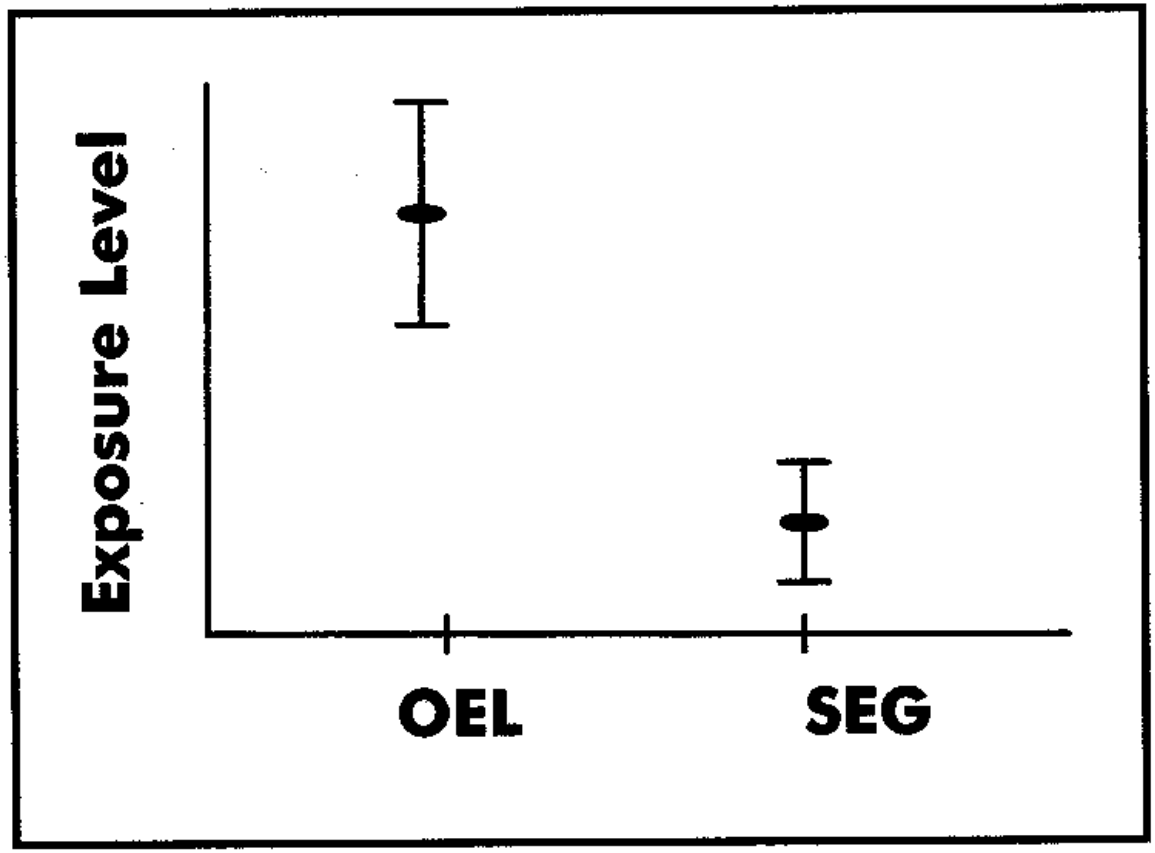

Figure 5.5 — Acceptable exposure.

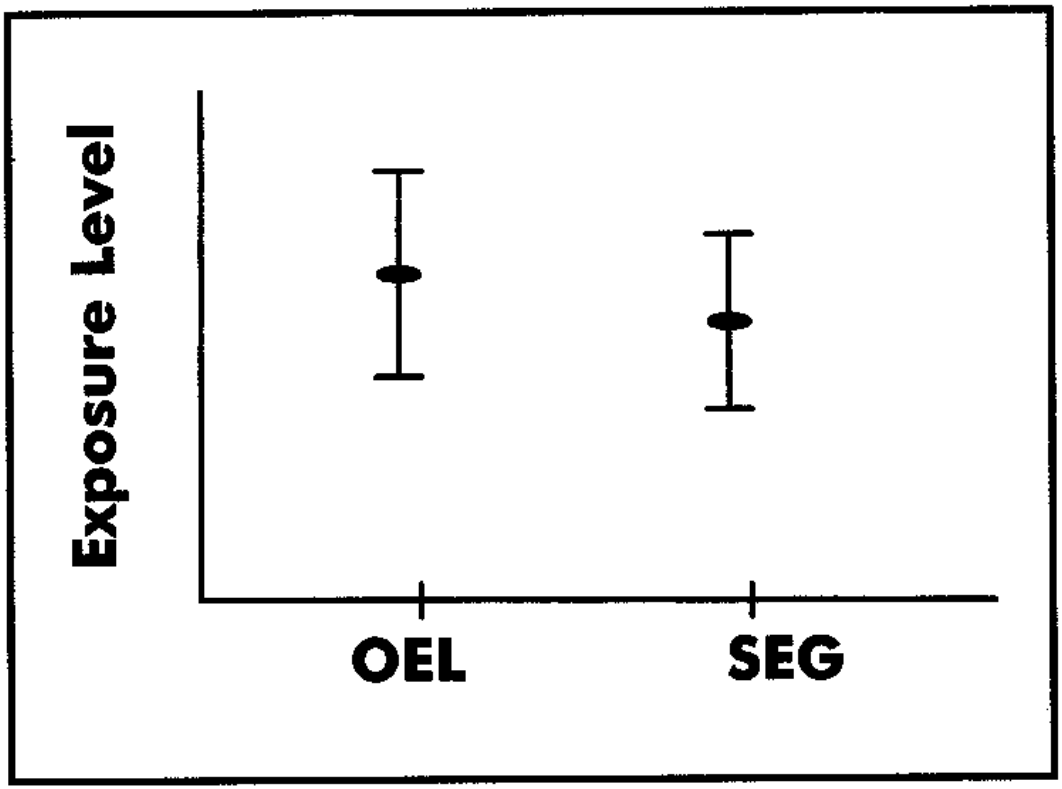

Figure 5.6 — Uncertain or unacceptable exposure.

Comparative Hazard Matrix Prioritizing SEGs

Health Effect Rating				
4	**4**	**8**	**12**	**16**
3	**3**	**6**	**9**	**12**
2	**2**	**4**	**6**	**8**
1	**1**	**2**	**3**	**4**
	1	2	3	4

Exposure Rating

Mulhausen and Damiano

AIHA Exposure Rating Categorization

Based on Arithmetic Mean Of Exposure Profile

4	**>LTA - OEL**
3	**50% - 100% LTA-OEL**
2	**10% - 50% LTA-OEL**
1	**<10% LTA-OEL**

Long-term average occupational exposure limit (LTA-OEL) is the acceptable average concentration of an environmental agent exhibiting cumulative adverse effects

Mulhausen and Damiano

AIHA Exposure Rating Categorization

Based on Estimate Of 95th Percentile Relative To OEL

4	**> 5% exceedance of the OEL (95th percentile > OEL)**
3	**>5% exceedance of 0.5 x OEL (95th percentile between 0.5 x OEL and 1.0 x OEL)**
	>5% exceedance of 0.1 x OEL (95th percentile between 0.1 x OEL and 0.5 x OEL)
2	**Little to no exceedance of 0.1 x OEL (95th percentile < 0.1 OEL)**
1	

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Mulhausen and Damiano

AIHA Exposure Assessment Strategy

4. Further Information Gathering
   - Exposure Monitoring
   - Exposure Modeling
   - Biological Monitoring
   - Toxicology Data Generation
   - Epidemiological Data Generation

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Prioritizing Information Gathering

Health Effect Rating	Certain 0	Uncertain 1	Highly Uncertain 2
16	**0**	**16**	**32**
12	**0**	**12**	**24**
9	**0**	**9**	**18**
8	**0**	**8**	**16**
6	**0**	**6**	**12**
4	**0**	**4**	**8**
3	**0**	**3**	**6**
2	**0**	**2**	**4**
1	**0**	**1**	**2**

Uncertainty Rating

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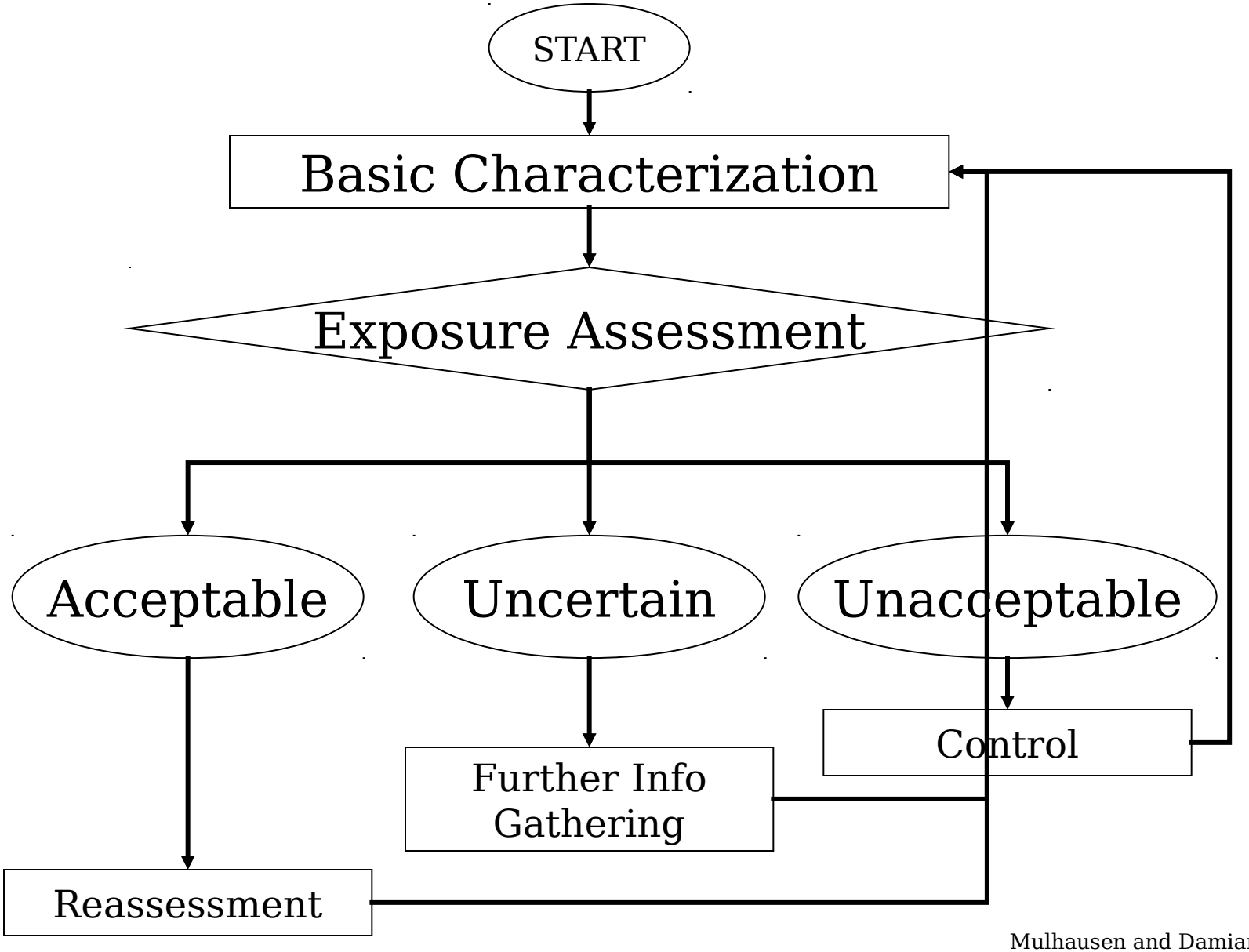
EXPOSURE ASSESSMENT STRATEGY



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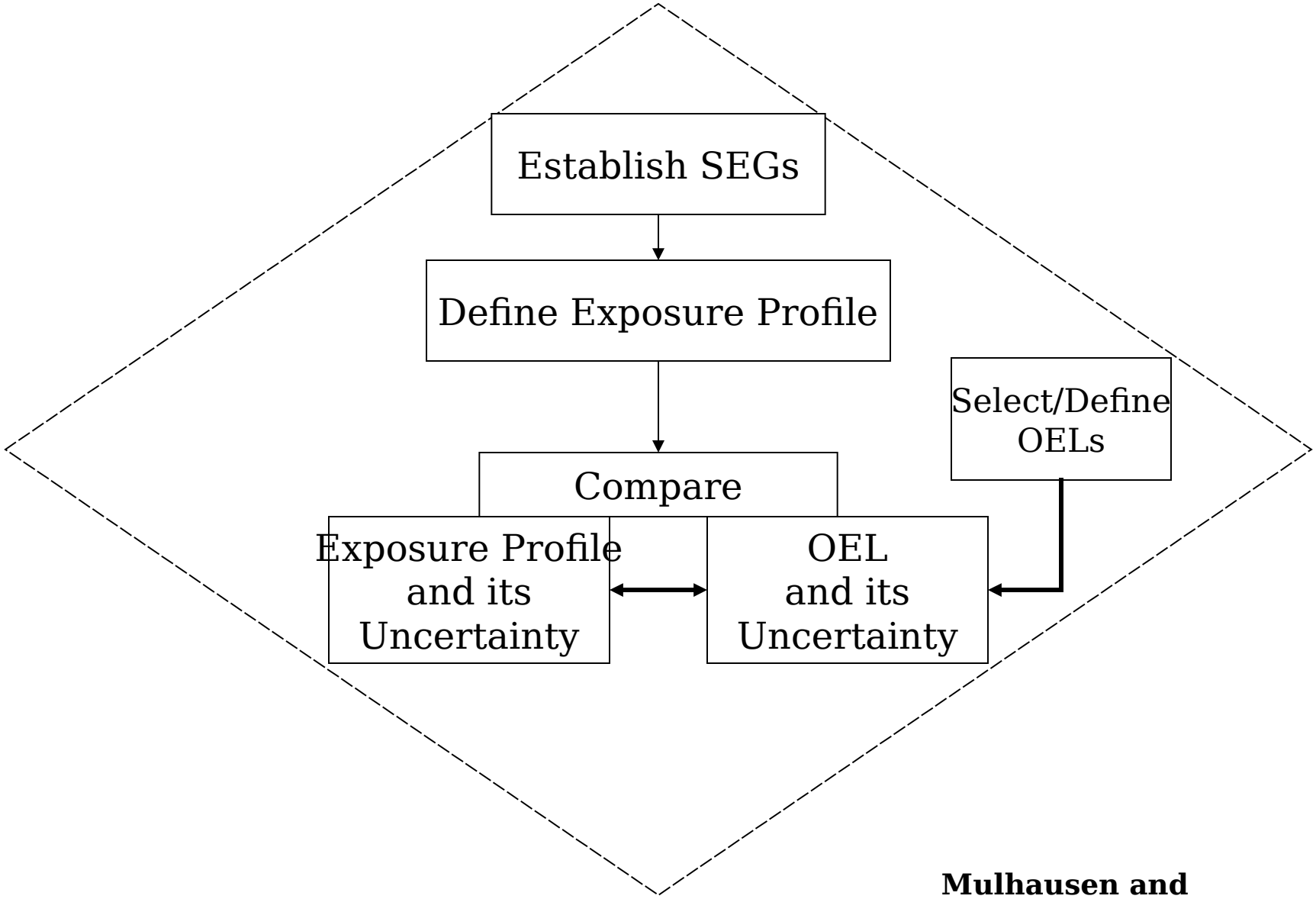
EXPOSURE ASSESSMENT



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- **Iterative**

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- Profitability, Enhance Performance, "Bottom Line"
- **Systematically reduce uncertainty and prioritize effort**

The Future ???

- The World - “ Are PELs relevant to global corporations?”
- DOD/Navy -
  - Need Better RAC system
  - DOEHRS for IH?

The Future ???

- The IH Profession
  - Life Cycle Analysis - integrate human and ecotoxicology, exposure assessment, recycling and power consumption
  - Sensitive populations will drive the scientific and regulatory process
    - GMF (genetically modified food)
    - Office of Children's Health "Kiddie Act"
    - FQPA (Food Quality Protection Act) [pesticides]

The Future ???

- The IH Profession (cont'd)
  - OELs - Many are 30 years old. Expect 5-100 fold lower values for some
  - REA (Retrospective Exposure Assessment) - several have occurred in last 7 years - more to come

Take Home Points

- There is an historical and ongoing link between occupational exposure assessment and environmental risk assessment which will continue to have a significant effect on the practice of industrial hygiene

Take Home Points

- Risk assessment/risk management is a merger of science and judgement
- The use of risk assessment requires the admission of some level of acceptable risk
- Don’t do risk assessment if you are not going to make a decision

Take Home Points

- We need to be more quantitative and systematic in our approach to exposure assessments
- We need to acknowledge and manage uncertainty in our assessments
- We can do both of the above and improve the efficient use of limited resources by adopting an iterative approach to our decision making